

T6M27S

T6M27S CMOS 1 CHIP LSI FOR LCD ELECTRONIC CALCULATOR

The T6M27S is a 1 chip microcomputer for 8-digits + 1-digit electronic scientific calculation.

T6M27S is the complete single chip CMOS LSI for electronic calculator with 8 digit, 27 function, and fractional number calculation with the following features.

FEATURES

- Display 8 display digits plus 1 digits code at the right margin.

- Scientific display.

Mantissa 6 digits plus exponent 2 digits plus negative code 2 digits.

- Fractional number display.

9 digits plus negative code 1 digit.

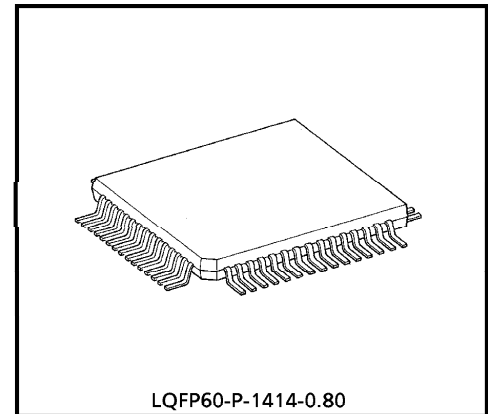
- Other than above

Mantissa 8 digits plus negative code 1 digit.

- 9 kinds of special display

M	Memory	DEG	Degree
-	Minus	RAD	Radian
E	Error	GRAD	Gradian
INV	Inverse	()	Parenthesis calculation

- The minus sign of the mantissa is floating minus.
- The arithmetic key operation in clouding Y^x has same sequence as mathematical equation. 4 pending operations are allowed and () are up to continuous 15 levels.
- Fractional number calculation.
- One independent accumulating memory.
- Direct drive for FEM LCD (1/3 prebias, 1/4 duty) .
- Automatic power on clear.
- Low power consumption. $V_{SS} = -3.0V$ single power supply.
- The 60 pin flat package is used.



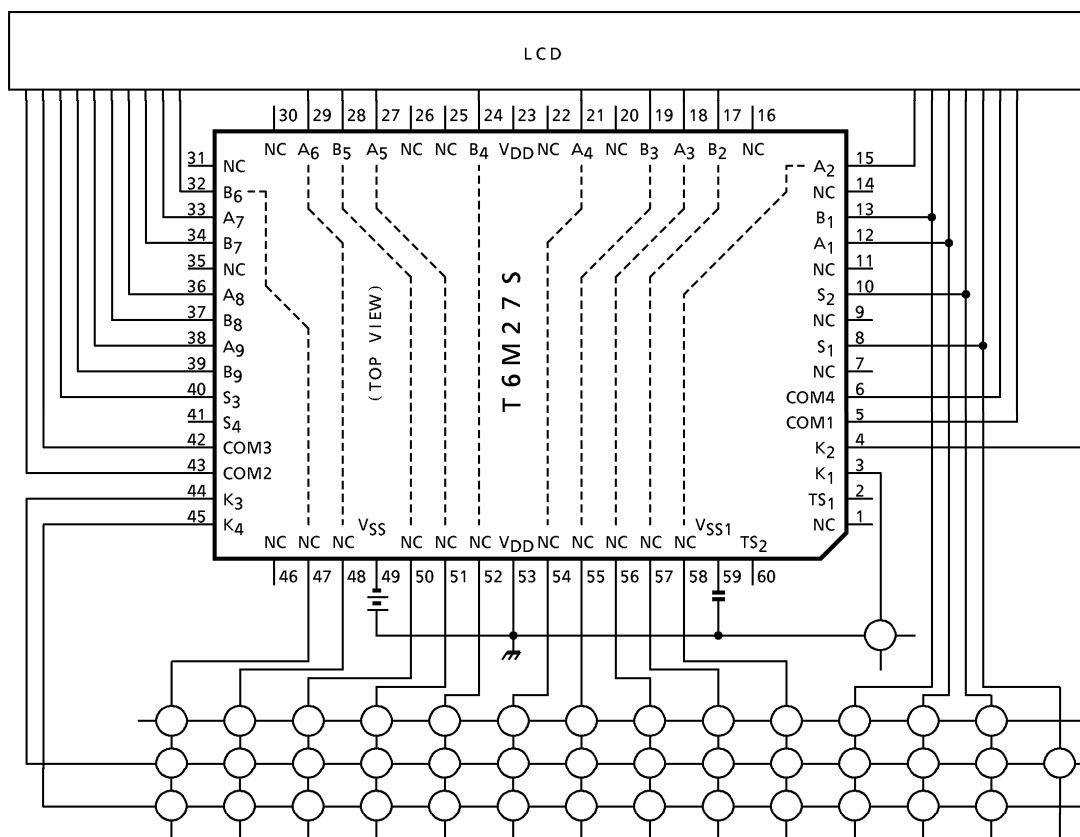
LQFP60-P-1414-0.80

Weight : 0.66g (Typ.)

980910EBA2

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SYSTEM BLOCK DIAGRAM



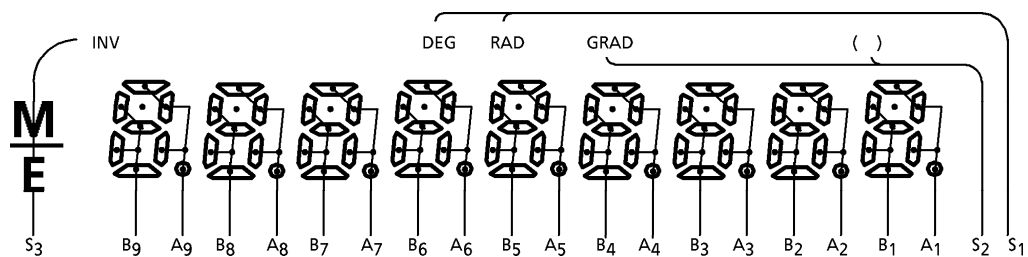
(Note) Input capacity ≤ 300 (pF) at $V_{DD} = -2.6$ (V)
 Key resistance ≤ 1.5 (k Ω) at $V_{DD} = -2.6$ (V)

980910EBA2'

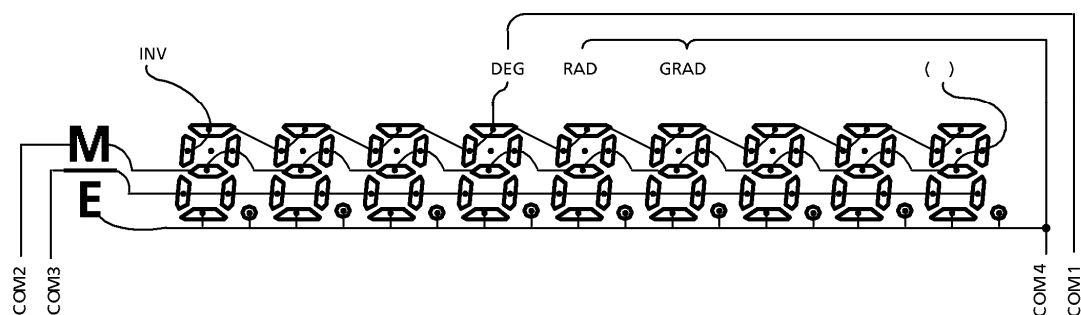
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CONNECTION OF LCD

SEGMENT



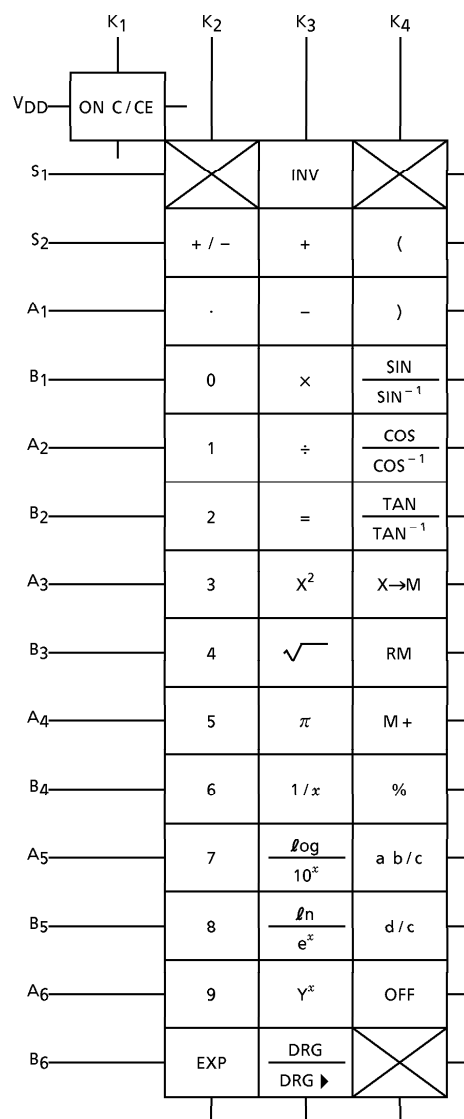
COMMON



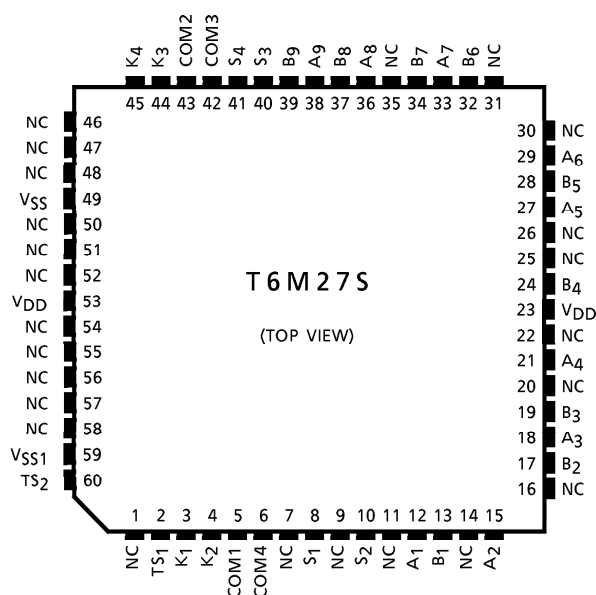
SET KEY LAYOUT (Example)

INV		OFF		ON C / CE	
SIN SIN ⁻¹	COS COS ⁻¹	TAN TAN ⁻¹	DRG DRG▶	π	%
ln e ^x	log 10 ^x	Y ^x	x ²	√	1 / x
RM	X→M	M +	a b / c	d / c	
7	8	9	()	
4	5	6	×	÷	
1	2	3	+	-	
0	.	+ / -	EXP	=	

KEY LAYOUT



PIN LAYOUT



OPERATION EXAMPLE

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Addition, Subtraction				
● $123 + 654 = 777$	123 $\boxed{+}$ 654 $\boxed{=}$	777		
● $19 + 19 + 19 + 19 = 76$	19 $\boxed{+}$ $\boxed{=}$ $\boxed{=}$ $\boxed{=}$	76		
● $2.34 - 3.45 = -1.11$	2.34 $\boxed{-}$ 3.45 $\boxed{=}$	-1.11		
Multiplication, Division				
● $98765 \times (-4321)$ $= -4.26763 \times 10^8$	98765 $\boxed{\times}$ 4321 $\boxed{+/-}$ $\boxed{=}$	-4.26763		08
● $(4.5 \times 10^6) \div 7.8 = 576923.08$	4.5 $\boxed{\text{EXP}}$ 6 $\boxed{\div}$ 7.8 $\boxed{=}$	576923.08		
Parenthesis				
● $\frac{11 - 13}{15 + 17} = -0.0625$	$\boxed{(} \boxed{11} \boxed{-} \boxed{13} \boxed{)} \boxed{\div} \boxed{(} \boxed{15} \boxed{+} \boxed{17} \boxed{)} \boxed{=}$	-0.0625		
● $98 \div [(7 + 4) \times (5 - 6)] = -8.9090909$	$98 \boxed{\div} \boxed{(} \boxed{(} \boxed{7} \boxed{+} \boxed{4} \boxed{)} \boxed{\times} \boxed{(} \boxed{5} \boxed{-} \boxed{6} \boxed{)} \boxed{=}$	-8.9090909		

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Constant Calculation				
● 0.12 + 0.78 = 0.9 0.34 + 0.78 = 1.12 0.56 + 0.78 = 1.34	0.12 $\boxed{+}$ 0.78 $\boxed{=}$ 0.34 $\boxed{=}$ 0.56 $\boxed{=}$	0.9 1.12 1.34		
● 987 - 100 = 887 654 - 100 = 554 321 - 100 = 221	987 $\boxed{-}$ 100 $\boxed{=}$ 654 $\boxed{=}$ 321 $\boxed{=}$	887 554 221		
● 1.1 × 4.4 = 4.84 2.2 × 4.4 = 9.68 3.3 × 4.4 = 14.52	1.1 $\boxed{\times}$ 4.4 $\boxed{=}$ 2.2 $\boxed{=}$ 3.3 $\boxed{=}$	4.84 9.68 14.52		
● 500 ÷ 4 = 125 600 ÷ 4 = 150 700 ÷ 4 = 175	500 $\boxed{\div}$ 4 $\boxed{=}$ 600 $\boxed{=}$ 700 $\boxed{=}$	125 150 175		
● 2 ⁵ = 32 3 ⁵ = 243 4 ⁵ = 1024	2 $\boxed{y^x}$ 5 $\boxed{=}$ 3 $\boxed{=}$ 4 $\boxed{=}$	32 243 1024		
● 12.3 + 4 × 5.6 = 34.7 23.4 + 4 × 5.6 = 45.8 34.5 + 4 × 5.6 = 56.9	12.3 $\boxed{+}$ 4 $\boxed{\times}$ 5.6 $\boxed{=}$ 23.4 $\boxed{=}$ 34.5 $\boxed{=}$	34.7 45.8 56.9		
Memory Calculation				
(Total calculation) 9 × 8 = 72 7 × 6 = 42 +) 5 × 4 = 20 134	$\boxed{C} \boxed{\cdot} \boxed{CE} \boxed{X} \rightarrow \boxed{M} \boxed{9} \boxed{\times} \boxed{8} \boxed{=}$ $\boxed{M} \boxed{+}$ 7 $\boxed{\times} \boxed{6} \boxed{=}$ $\boxed{M} \boxed{+}$ 5 $\boxed{\times} \boxed{4} \boxed{=}$ $\boxed{M} \boxed{+}$ \boxed{RM}	72 42 20 134		
Fractional Calculation				
● $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} = 1\frac{1}{12}$	1 $\boxed{ab/c}$ 2 $\boxed{+}$ 1 $\boxed{ab/c}$ 3 $\boxed{+}$ 1 $\boxed{ab/c}$ 4 $\boxed{=}$ $\boxed{d/c}$ $\boxed{ab/c}$ $\boxed{ab/c}$	1 $\frac{1}{12}$ 13 $\frac{1}{12}$ 1.0833333 1 $\frac{1}{12}$		
● $5\frac{1}{6} - 7\frac{1}{8} = -1\frac{23}{24}$	5 $\boxed{ab/c}$ 1 $\boxed{ab/c}$ 6 $\boxed{-}$ 7 $\boxed{ab/c}$ 1 $\boxed{ab/c}$ 8 $\boxed{=}$ $\boxed{d/c}$ $\boxed{ab/c}$	- 1 $\frac{23}{24}$ - 47 $\frac{23}{24}$ - 1.9583333		

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Functional Calculation				
(Trigonometry)				
• $\sin 30^\circ = 0.5$ [DEG]	$\boxed{\text{DRG}} \boxed{[\text{DEG}]} \boxed{30} \boxed{\text{SIN}}$	0.5	[DEG]	
• $\cos \frac{2}{3} \pi$ [RAD] = - 0.5	$\boxed{\text{DRG}} \boxed{[\text{RAD}]} \boxed{(} \boxed{2} \boxed{\div} \boxed{3} \boxed{\times} \boxed{\pi} \boxed{)} \boxed{\text{COS}}$	- 0.5	[RAD]	
• $\tan 150^\circ = - 1$ [GRAD]	$\boxed{\text{DRG}} \boxed{[\text{GRAD}]} \boxed{150} \boxed{\text{TAN}}$	- 1	[GRAD]	
• $1 - \cos^2 60^\circ = 0.75$ [DEG]	$\boxed{\text{DRG}} \boxed{[\text{DEG}]} \boxed{1} \boxed{-} \boxed{60} \boxed{\text{COS}} \boxed{x^2} \boxed{=}$	0.75	[DEG]	
(Inverse trigonometry)				
• $\sin^{-1} 0.5 = - 30^\circ$ [DEG]	$\boxed{\text{DRG}} \boxed{[\text{DEG}]} \boxed{0.5} \boxed{+/-} \boxed{\text{SIN}^{-1}}$	- 30	[DEG]	
• $\cos^{-1} - 1$ = 3.1415927 [RAD]	$\boxed{\text{DRG}} \boxed{[\text{RAD}]} \boxed{1} \boxed{+/-} \boxed{\text{COS}^{-1}}$	3.1415927	[RAD]	
• $\tan^{-1} 1 = 50^\circ$ [GRAD]	$\boxed{\text{DRG}} \boxed{[\text{GRAD}]} \boxed{1} \boxed{\text{TAN}^{-1}}$	50	[GRAD]	
(Exponential)				
• $e^1 = 2.7182818$	$\boxed{1} \boxed{e^x}$	2.7182818		
• $e^{1.5} \times 10^{2.5} = 1417.2345$	$\boxed{1.5} \boxed{e^x} \boxed{\times} \boxed{2.5} \boxed{10^x} \boxed{=}$	1417.2345		
(Natural logarithm)				
• $\ln 30 = 3.4011974$	$\boxed{30} \boxed{\text{LN}}$	3.4011974		
(Common logarithm)				
• $\log 100 = 2$	$\boxed{100} \boxed{\text{LOG}}$	2		
• $\log \sqrt{3} + \log \sqrt{5}$ = 0.5880456	$\boxed{3} \boxed{\sqrt{}} \boxed{\text{LOG}} \boxed{+} \boxed{5} \boxed{\sqrt{}} \boxed{\text{LOG}} \boxed{=}$	0.5880456		
(Square root)				
• $\sqrt{2} = 1.4142136$	$\boxed{2} \boxed{\sqrt{}}$	1.4142136		
• $\sqrt{5} \times \sqrt{7} = 5.9160798$	$\boxed{5} \boxed{\sqrt{}} \boxed{\times} \boxed{7} \boxed{\sqrt{}} \boxed{=}$	5.9160798		
(Square)				
• $3^2 + 4^2 = 25$	$\boxed{3} \boxed{x^2} \boxed{+} \boxed{4} \boxed{x^2} \boxed{=}$	25		
• $(2.34 \times 10^5)^2$ = 5.4756×10^{10}	$\boxed{2.34} \boxed{\text{EXP}} \boxed{5} \boxed{x^2}$	5.4756		10
(Power)				
• $2^{10} = 1024$	$\boxed{2} \boxed{y^2} \boxed{10} \boxed{=}$	1024		
• $3^{-19} = 8.60391 \times 10^{-10}$	$\boxed{3} \boxed{y^2} \boxed{19} \boxed{+/-} \boxed{=}$	8.60391	-	10
• $\sqrt[3]{8} (= 8^{1/3}) = 2$	$\boxed{8} \boxed{y^2} \boxed{3} \boxed{1/x} \boxed{=}$	2		
• $\sqrt[4]{81} = 3$	$\boxed{81} \boxed{\sqrt{}} \boxed{\sqrt{}}$	3		
(Reciprocal)				
• $\frac{1}{3} + \frac{1}{5} = 0.5333333$	$\boxed{3} \boxed{1/x} \boxed{+} \boxed{5} \boxed{1/x} \boxed{=}$	0.5333333		
• $\frac{1}{1.23 \times 10^{17}}$ = 8.13008×10^{-18}	$\boxed{1.23} \boxed{\text{EXP}} \boxed{17} \boxed{1/x}$	8.13008	-	18
Pi Calculation				
• $5 \times \pi = 15.707963$	$\boxed{5} \boxed{\times} \boxed{\pi} \boxed{=}$	15.707963		

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Percent Calculation				
<ul style="list-style-type: none">What is 15% of 400? $400 \times \frac{15}{100} = 60$	400 <input type="text" value="x"/> 15 <input type="text" value="%"/> <input type="text" value="="/>	60		
<ul style="list-style-type: none">3 equals what percent of 24? $\frac{3}{24} \times 100 = 12.5$	3 <input type="text" value="÷"/> 24 <input type="text" value="%"/> <input type="text" value="="/>	12.5		
<ul style="list-style-type: none">A 25% add on to 800 $800 + 800 \times \frac{25}{100} = 1000$	800 <input type="text" value="+"/> 25 <input type="text" value="%"/> <input type="text" value="="/>	1000		
<ul style="list-style-type: none">A 18% deduction on 700 $700 - 700 \times \frac{18}{100} = 574$	700 <input type="text" value="-"/> 18 <input type="text" value="%"/> <input type="text" value="="/>	574		

MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{SS}	+ 0.3 ~ - 3.5	V
Input Voltage	V_{IN}	+ 0.3 ~ V_{DD} - 0.3	V
Operating Temperature	T_{opr}	0 ~ 40	°C
Storage Temperature	T_{stg}	- 55 ~ 125	°C

ELECTRICAL CHARACTERISTICS ($V_{SS} = -3.0 \pm 0.2V$, $V_{DD} = 0V$, $T_a = 25 \pm 1.5^\circ C$)

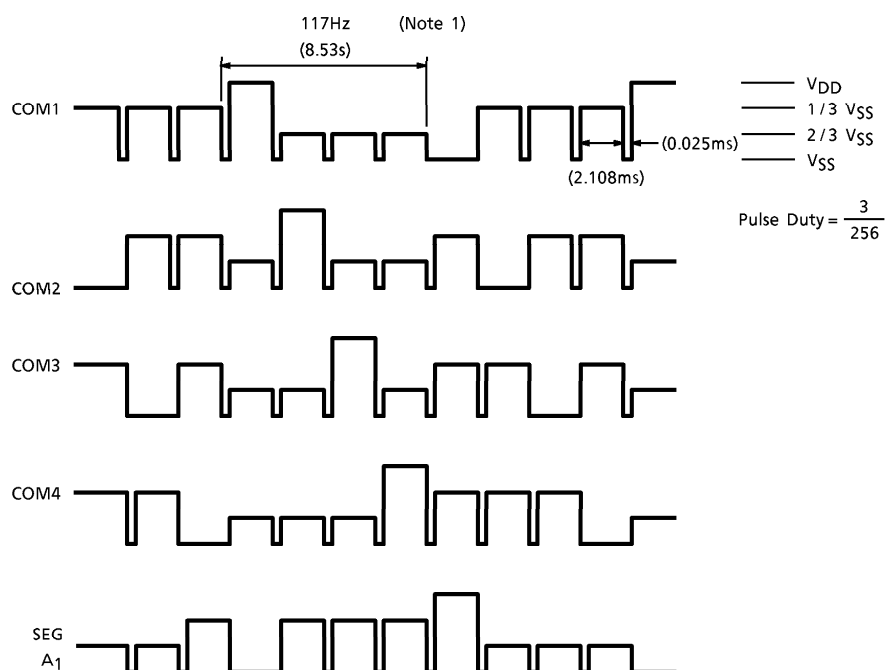
PARAMETER	SYMBOL	TEST CIRCUIT	PIN NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	—	—	—	—	- 2.5	- 3.0	- 3.4	V
Supply Current	I_{DD} WAIT	—	—	$V_{SS} = -3.0V$, wait	—	26	—	μA
Supply Current	I_{DD} OP	—	—	$V_{SS} = -3.0V$, operate	—	52	78	μA
Supply Current	I_{DD} OFF	—	—	$V_{SS} = -3.0V$, off	—	1	3	μA
Oscillating Frequency	f_{ϕ} WAIT	—	—	$V_{SS} = -3.0V$, wait	18	30	42	kHz
Oscillating Frequency	f_{ϕ} OP	—	—	$V_{SS} = -3.0V$, operate	42	70	98	kHz
Frame Frequency	fF	—	—	$V_{SS} = -3.0V$, wait	70	117	164	Hz
Timer	T timer	—	—	$V_{SS} = -3.0V$	428	600	1000	s
"1" Input Voltage	V_{IH}	—	$K_1 \sim K_4$	—	$V_{SS} + 0.5$	—	V_{SS}	V
"0" Input Voltage	V_{IL}	—	$K_1 \sim K_4$	—	V_{DD}	—	- 0.5	V
"1" Output Resistance	R_{KEY}	—	SEG	$V_{OUT} = V_{SS} + 0.5V$: KEY STROBE	—	—	2	$k\Omega$
"0" Output Resistance	R_{SEG} (L)	—	SEG	$V_{OUT} = V_{DD} - 0.5V$	—	—	90	$k\Omega$

PARAMETER	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
"1" Output Resistance	R _{SEG} (H)	—	SEG	V _{OUT} = V _{SS} + 0.5V : KEY STROBE	—	—	90	kΩ
"0" Output Resistance	R _{COM} (L)	—	COM	V _{OUT} = V _{DD} - 0.5V	—	—	25	kΩ
"1" Output Resistance	R _{COM} (H)	—	COM	V _{OUT} = V _{SS} + 0.5V	—	—	25	kΩ
KEY PULL UP Resistance	R _{PULL UP}	—	K ₁	V _{OUT} = 0V	27	45	63	kΩ
KEY PULL DOWN Resistance	R _{PULL DOWN}	—	K ₂ ~K ₄	V _{OUT} = V _{SS}	27	45	63	kΩ
"M" Output Resistance	R _{OM}	—	SEG	V _{OUT} = $\frac{1}{3}$ V _{SS} - 0.5V	—	100	—	kΩ
"M" Output Resistance	R _{OM}	—	SEG	V _{OUT} = $\frac{2}{3}$ V _{SS} + 0.5V	—	100	—	kΩ
"M" Output Resistance	R _{OM}	—	COM	V _{OUT} = $\frac{1}{3}$ V _{SS} - 0.5V	—	77	—	kΩ
"M" Output Resistance	R _{OM}	—	COM	V _{OUT} = $\frac{2}{3}$ V _{SS} + 0.5V	—	77	—	kΩ
"1" Output Voltage	V _{OH}	—	K ₁	(Note 1)	V _{SS} + 0.2	V _{SS}	V _{SS}	V
"0" Output Voltage	V _{OL}	—	K ₂ ~K ₄	(Note 1)	V _{DD}	V _{DD}	V _{DD} - 0.2	V
"1" Output Voltage	V _{OH}	—	SEG COM	—	V _{SS} + 0.2	V _{SS}	V _{SS}	V
"M" Output Voltage	V _{OM}	—	SEG COM	—	$\frac{2}{3}$ V _{SS} + 0.2	$\frac{2}{3}$ V _{SS}	$\frac{2}{3}$ V _{SS} - 0.2	V
"M" Output Voltage	V _{OM}	—	SEG COM	—	$\frac{1}{3}$ V _{SS} + 0.2	$\frac{1}{3}$ V _{SS}	$\frac{1}{3}$ V _{SS} - 0.2	V
"0" Output Voltage	V _{OL}	—	SEG COM	—	V _{DD}	V _{DD}	V _{DD} - 0.2	V

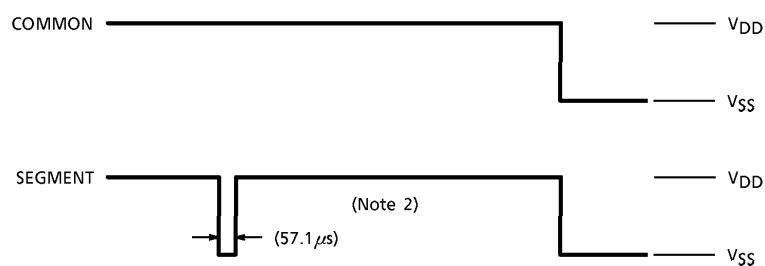
(Note 1) The key buffer is high impedance at keystroke.

WAVEFORMS FOR DISPLAY

Display



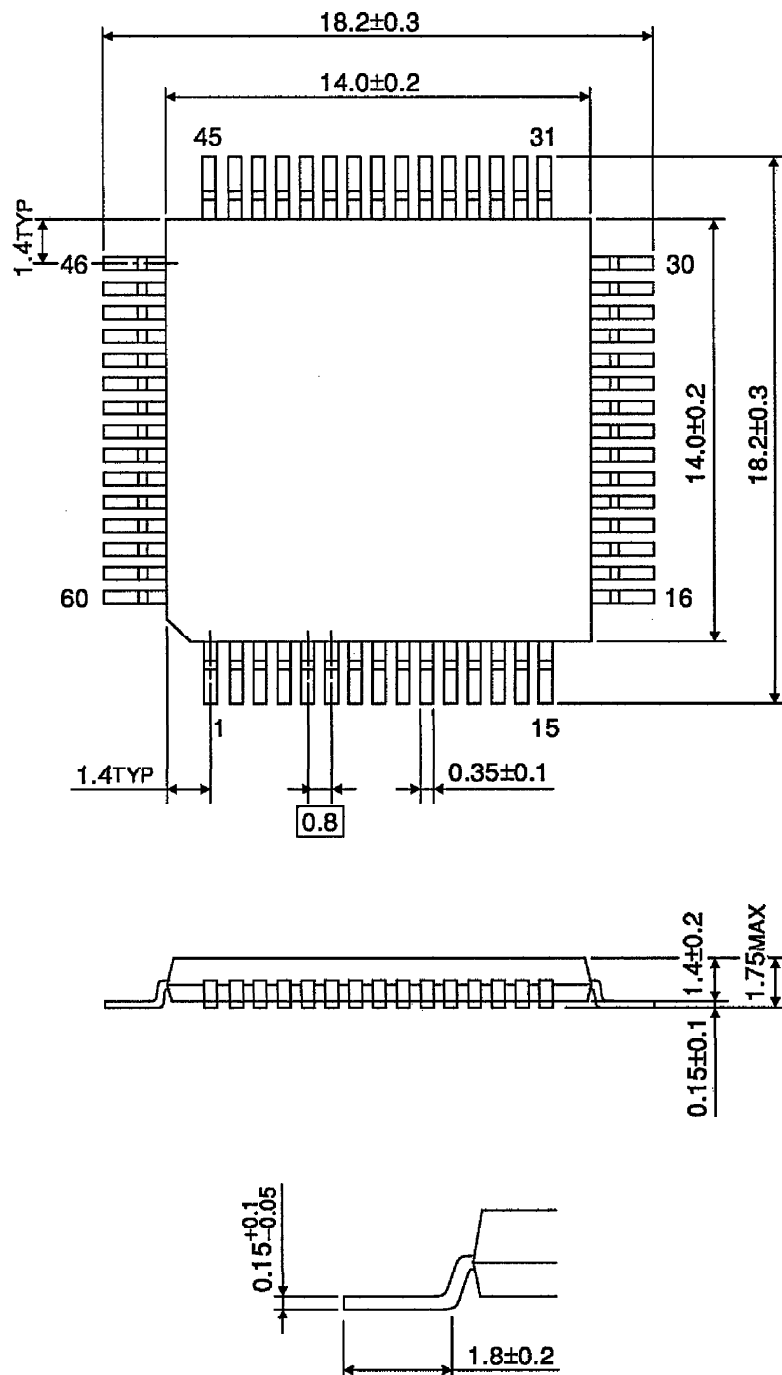
Key pulse output

(Note 1) $F_{\phi} \text{ WAIT} = 30\text{kHz}$ (Note 2) $F_{\phi} \text{ OP} = 70\text{kHz}$

OUTLINE DRAWING

LQFP60-P-1414-0.80

Unit : mm



Weight : 0.66g (Typ.)